

CLAIMS

What is claimed is:

1. A wavelength division multiplexing device comprising:
 2. a polymer collimating lens for collimating a plurality of monochromatic optical beams;
 4. a diffraction grating for combining the plurality of collimated, monochromatic optical beams into a multiplexed, polychromatic optical beam; and
 7. a polymer focusing lens for focusing the multiplexed, polychromatic optical beam.
1. 2. The device as defined in claim 1, wherein the diffraction grating is a transmissive diffraction grating.
1. 3. The device as defined in claim 2, further comprising:
 2. a transmissive element associated with the transmissive diffraction grating, the transmissive element having at least one reflective surface for reflecting the multiplexed, polychromatic optical beam.

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1 4. The device as defined in claim 2, further comprising:
2 a transmissive element associated with the transmissive
3 diffraction grating, the transmissive element having at
4 least one reflective surface for reflecting the plurality of
5 collimated, monochromatic optical beams.

1 5. The device as defined in claim 1, wherein the polymer
2 collimating lens and the polymer focusing lens operate in
3 the infrared region of the electromagnetic spectrum.

1 6. The device as defined in claim 1, wherein at least one
2 of the polymer collimating lens and the polymer focusing
3 lens is a plano-convex lens or a convex-plano lens.

1 7. The device as defined in claim 1, wherein at least one
2 of the polymer collimating lens and the polymer focusing
3 lens is a bi-convex lens.

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1 8. The device as defined in claim 1, wherein at least one
2 of the polymer collimating lens and the polymer focusing
3 lens is a spherical lens.

1 9. The device as defined in claim 1, wherein at least one
2 of the polymer collimating lens and the polymer focusing
3 lens is an aspherical lens.

1 10. The device as defined in claim 1, wherein the polymer
2 collimating lens and the polymer focusing lens are formed of
3 a polymer material selected from the group consisting of
4 acrylic, styrene, polycarbonate, copolymers thereof, and
5 other polymer materials that efficiently transmit optical
6 beams in the infrared region of the electromagnetic
7 spectrum.

1 11. An integrated wavelength division multiplexing device
2 comprising:

3 a polymer collimating lens for collimating a plurality
4 of monochromatic optical beams;

5 a boot lens affixed to the polymer collimating lens for
6 transmitting the plurality of collimated, monochromatic
7 optical beams from the polymer collimating lens, the boot
8 lens having a planar exit surface; and

9 a diffraction grating formed at the planar exit surface
10 of the boot lens for combining the plurality of collimated,
11 monochromatic optical beams into a multiplexed,
12 polychromatic optical beam.

1 12. The device as defined in claim 11, wherein the boot
2 lens is incorporated into the polymer collimating lens such
3 that the polymer collimating lens has the planar exit
4 surface at which the diffraction grating is formed.

1 13. The device as defined in claim 11, wherein the boot
2 lens is a first boot lens, the device further comprising:
3 a second boot lens affixed to the polymer collimating
4 lens for transmitting the plurality of monochromatic optical
5 beams to the polymer collimating lens.

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1 14. The device as defined in claim 13, wherein the second
2 boot lens has a planar entry surface for accepting the
3 plurality of monochromatic optical beams from at least one
4 optical source.

1 15. The device as defined in claim 11, wherein the polymer
2 collimating lens has a planar entry surface for accepting
3 the plurality of monochromatic optical beams from at least
4 one optical source.

1 16. The device as defined in claim 11, wherein the
2 diffraction grating is a transmissive diffraction grating.

1 17. The device as defined in claim 16, further comprising:
2 a transmissive element associated with the transmissive
3 diffraction grating, the transmissive element having at
4 least one reflective surface for reflecting the multiplexed,
5 polychromatic optical beam.

1 18. The device as defined in claim 17, wherein the boot
2 lens is a first boot lens, the device further comprising:

3 a second boot lens affixed to the transmissive element
4 for transmitting the multiplexed, polychromatic optical beam
5 from the transmissive element; and

6 a polymer focusing lens affixed to the second boot lens
7 for focusing the multiplexed, polychromatic optical beam.

1 19. The device as defined in claim 18, wherein the second
2 boot lens is incorporated into the polymer focusing lens
3 such that the polymer focusing lens is affixed to the
4 transmissive element.

1 20. The device as defined in claim 18, further comprising:
2 a third boot lens affixed to the polymer focusing lens
3 for transmitting the focused, multiplexed, polychromatic
4 optical beam from the polymer focusing lens.

1 21. The device as defined in claim 20, wherein the third
2 boot lens has a planar exit surface for outputting the
3 focused, multiplexed, polychromatic optical beam to at least
4 one optical receiver.

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1 22. The device as defined in claim 18, wherein the polymer
2 focusing lens has a planar exit surface for outputting the
3 focused, multiplexed, polychromatic optical beam to at least
4 one optical receiver.

1 23. An integrated wavelength division multiplexing device
2 comprising:

3 a polymer focusing lens for focusing a multiplexed,
4 polychromatic optical beam;

5 a boot lens affixed to the polymer focusing lens for
6 transmitting the multiplexed, polychromatic optical beam to
7 the polymer focusing lens, the boot lens having a planar
8 entry surface; and

9 a diffraction grating formed at the planar entry
10 surface of the boot lens for combining a plurality of
11 monochromatic optical beams into the multiplexed,
12 polychromatic optical beam.

1 24. The device as defined in claim 23, wherein the boot
2 lens is incorporated into the polymer focusing lens such

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3 that the polymer focusing lens has the planar entry surface
4 at which the diffraction grating is formed.

1 25. The device as defined in claim 23, wherein the
2 diffraction grating is a transmissive diffraction grating.

1 26. The device as defined in claim 25, further comprising:
2 a transmissive element associated with the transmissive
3 diffraction grating, the transmissive element having at
4 least one reflective surface for reflecting the plurality of
5 monochromatic optical beams toward the transmissive
6 diffraction grating.

1 27. The device as defined in claim 26, wherein the boot
2 lens is a first boot lens, the device further comprising:
3 a second boot lens affixed to the transmissive element
4 for transmitting the plurality of monochromatic optical
5 beams to the transmissive element; and
6 a polymer collimating lens affixed to the second boot
7 lens for collimating the plurality of monochromatic optical
8 beams prior to transmission by the second boot lens.

1 28. The device as defined in claim 27, wherein the second
2 boot lens is incorporated into the polymer collimating lens
3 such that the polymer collimating lens is affixed to the
4 transmissive element.

1 29. A wavelength division demultiplexing device comprising:
2 a polymer collimating lens for collimating a
3 multiplexed, polychromatic optical beam;
4 a diffraction grating for separating the collimated,
5 multiplexed, polychromatic optical beam into a plurality of
6 monochromatic optical beams; and
7 a polymer focusing lens for focusing the plurality of
8 monochromatic optical beams.

1 30. The device as defined in claim 29, wherein the
2 diffraction grating is a transmissive diffraction grating.

1 31. The device as defined in claim 30, further comprising:
2 a transmissive element associated with the transmissive
3 diffraction grating, the transmissive element having at

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4 least one reflective surface for reflecting the collimated,
5 multiplexed, polychromatic optical beam.

1 32. The device as defined in claim 30, further comprising:
2 a transmissive element associated with the transmissive
3 diffraction grating, the transmissive element having at
4 least one reflective surface for reflecting the plurality of
5 monochromatic optical beams.

1 33. The device as defined in claim 29, wherein the polymer
2 collimating lens and the polymer focusing lens operate in
3 the infrared region of the electromagnetic spectrum.

1 34. The device as defined in claim 29, wherein at least one
2 of the polymer collimating lens and the polymer focusing
3 lens is a plano-convex lens or a convex-plano lens.

1 35. The device as defined in claim 29, wherein at least one
2 of the polymer collimating lens and the polymer focusing
3 lens is a bi-convex lens.

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1 36. The device as defined in claim 29, wherein at least one
2 of the polymer collimating lens and the polymer focusing
3 lens is a spherical lens.

1 37. The device as defined in claim 29, wherein at least one
2 of the polymer collimating lens and the polymer focusing
3 lens is an aspherical lens.

1 38. The device as defined in claim 29, wherein the polymer
2 collimating lens and the polymer focusing lens are formed of
3 a polymer material selected from the group consisting of
4 acrylic, styrene, polycarbonate, copolymers thereof, and
5 other polymer materials that efficiently transmit optical
6 beams in the infrared region of the electromagnetic
7 spectrum.

1 39. An integrated wavelength division demultiplexing device
2 comprising:

3 a polymer collimating lens for collimating a
4 multiplexed, polychromatic optical beam;

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5 a boot lens affixed to the polymer collimating lens for
6 transmitting the collimated, multiplexed, polychromatic
7 optical beam from the polymer collimating lens, the boot
8 lens having a planar exit surface; and

9 a diffraction grating formed at the planar exit surface
10 of the boot lens for separating the collimated, multiplexed,
11 polychromatic optical beam into a plurality of monochromatic
12 optical beams.

1 40. The device as defined in claim 39, wherein the boot
2 lens is incorporated into the polymer collimating lens such
3 that the polymer collimating lens has the planar exit
4 surface at which the diffraction grating is formed.

1 41. The device as defined in claim 39, wherein the boot
2 lens is a first boot lens, the device further comprising:
3 a second boot lens affixed to the polymer collimating
4 lens for transmitting the multiplexed, polychromatic optical
5 beam to the polymer collimating lens.

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1 42. The device as defined in claim 41, wherein the second
2 boot lens has a planar entry surface for accepting the
3 multiplexed, polychromatic optical beam from at least one
4 optical source.

1 43. The device as defined in claim 39, wherein the polymer
2 collimating lens has a planar entry surface for accepting
3 the multiplexed, polychromatic optical beam from at least
4 one optical source.

1 44. The device as defined in claim 39, wherein the
2 diffraction grating is a transmissive diffraction grating.

1 45. The device as defined in claim 44, further comprising:
2 a transmissive element associated with the transmissive
3 diffraction grating, the transmissive element having at
4 least one reflective surface for reflecting the plurality of
5 monochromatic optical beams.

1 46. The device as defined in claim 45, wherein the boot
2 lens is a first boot lens, the device further comprising:

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3 a second boot lens affixed to the transmissive element
4 for transmitting the plurality of monochromatic optical
5 beams from the transmissive element; and
6 a polymer focusing lens affixed to the second boot lens
7 for focusing the plurality of monochromatic optical beams.

1 47. The device as defined in claim 46, wherein the boot
2 lens is incorporated into the polymer focusing lens such
3 that the polymer focusing lens is affixed to the
4 transmissive element.

1 48. The device as defined in claim 46, further comprising:
2 a third boot lens affixed to the polymer focusing lens
3 for transmitting the plurality of focused, monochromatic
4 optical beams from the polymer focusing lens.

1 49. The device as defined in claim 48, wherein the third
2 boot lens has a planar exit surface for outputting the
3 plurality of focused, monochromatic optical beams to at
4 least one optical receiver.

1 50. The device as defined in claim 46, wherein the polymer
2 focusing lens has a planar exit surface for outputting the
3 plurality of focused, monochromatic optical beams to at
4 least one optical receiver.

1 51. An integrated wavelength division demultiplexing device
2 comprising:

3 a polymer focusing lens for focusing a plurality of
4 monochromatic optical beams;

5 a boot lens affixed to the polymer focusing lens for
6 transmitting the plurality of monochromatic optical beams to
7 the polymer focusing lens, the boot lens having a planar
8 entry surface; and

9 a diffraction grating formed at the planar entry
10 surface of the boot lens for separating a multiplexed,
11 polychromatic optical beam into the plurality of
12 monochromatic optical beams.

1 52. The device as defined in claim 51, wherein the boot
2 lens is incorporated into the polymer focusing lens such

3 that the polymer focusing lens has the planar entry surface
4 at which the diffraction grating is formed.

1 53. The device as defined in claim 51, wherein the
2 diffraction grating is a transmissive diffraction grating.

1 54. The device as defined in claim 53, further comprising:
2 a transmissive element associated with the transmissive
3 diffraction grating, the transmissive element having at
4 least one reflective surface for reflecting the multiplexed,
5 polychromatic optical beam toward the transmissive
6 diffraction grating.

1 55. The device as defined in claim 54, wherein the boot
2 lens is a first boot lens, the device further comprising:
3 a second boot lens affixed to the transmissive element
4 for transmitting the multiplexed, polychromatic optical beam
5 to the transmissive element; and
6 a polymer collimating lens affixed to the second boot
7 lens for collimating the multiplexed, polychromatic optical
8 beam prior to transmission by the second boot lens.

1 56. The device as defined in claim 55, wherein the second
2 boot lens is incorporated into the polymer collimating lens
3 such that the polymer collimating lens is affixed to the
4 transmissive element.